DOCUMENT RESUME

ED 306 912 HE 022 637

AUTHOR Holmes, Neal J.; Powers, Michael H.
TITLE Teacher, Industry and Environment (TIE).
INSTITUTION American Association of State Colleges and Universities, Washington, D.C.; Central Missouri State Univ., Warrensburg.
SPONS AGENCY Missouri State Dept. of Natural Resources, Jefferson City.; National Science Foundation, Washington, D.C.
PUB DATE Feb 87
GRANT NSF-8650101
NOTE 68p.; This report is one of a group gathered by the AASCU/ERIC Model Programs Inventory Project, funded by the Fund for the Improvement of Postsecondary Education to the American Association of State Colleges and Universities, in collaboration with the ERIC Clearinghouse on Higher Education. For related documents, see HE 022 565-617, HE 022 619-643 and HE 022 645-659. Also sponsored by the Missouri Chemical Council.
PUB TYPE Reports - Descriptive (141) -- Tests/Evaluation Instruments (160)

EDRS PRICE MF01/PC03 Plus Postage.
DESCRIPTORS *Chemistry; Educational Technology; Faculty Development; Higher Education; Models; Participant Satisfaction; Professional Training; Program Descriptions; Questionnaires; Secondary School Science; *Secondary School Teachers; State Universities; *Teacher Improvement
IDENTIFIERS *AASCU ERIC Model Programs Inventory Project; *Central Missouri State University

ABSTRACT

A description of the Teacher, Industry and Environment (TIE) educational improvement project at Central Missouri State Univesity is provided in this report. TIE is designed for Missouri high school chemistry teachers, involving 73 of them in a weekend workshop, meeting with chemists, engineers, and educators to assist them in using resources beyond the standard textbook. Following the workshop, they designed and developed a teaching packet or research project and participated in a Reporting Conference in which they reported on their packets or projects. Among TIE's objectives are: to enrich participant knowledge of the chemical industry of Missouri and the Missouri Department of Natural Resources; to enrich opportunities regarding the applications of computers; and to find examples of laboratory activities and research projects that have shown promise. Probably the single most exciting unanticipated outcome of the TIE conference is the desire of other states to host their own TIE workshop. Appended are: the 1987 TIE workshop evaluation; the TIE pre-workshop questionnaire; the TIE 87 reporting conference evaluation; the TIE participant survey; and the TIE 87 teacher participant list. Tables are included. Contains 10 references. (Author/SM)

ED306912

TEACHER, INDUSTRY AND ENVIRONMENT (TIE)

Institution: Central Missouri State University
Warrensburg, Missouri 64093

Contact Persons: Dr. Neal J. Holmes
Project TIE Co-Director
Department of Curriculum and Instruction
Central Missouri State University
Warrensburg, Missouri 64093

Dr. Michael H. Powers
Project TIE Co-Director
Department of Chemistry
Central Missouri State University
Warrensburg, Missouri 64093

Funding Agency: National Science Foundation
(NSF Award No. 8650101)
Missouri Chemical Council
Department of Natural Resources
Central Missouri State University

Date: February 1987

BEST COPY AVAILABLE

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

☑ This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

Michael H. Powers

Central Missouri State University

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

HE022637

AASCU/ERIC Model Programs Inventory Project

The AASCU/ERIC Model Programs Inventory is a two-year project seeking to establish and test a model system for collecting and disseminating information on model programs at AASCU-member institutions--375 of the public four-year colleges and universities in the United States.

The four objectives of the project are:

- To increase the information on model programs available to all institutions through the ERIC system
- To encourage the use of the ERIC system by AASCU institutions
- To improve AASCU's ability to know about, and share information on, activities at member institutions, and
- To test a model for collaboration with ERIC that other national organizations might adopt.

The AASCU/ERIC Model Programs Inventory Project is funded with a grant from the Fund for the Improvement of Postsecondary Education to the American Association of State Colleges and Universities, in collaboration with the ERIC Clearinghouse on Higher Education at The George Washington University.

TEACHER, INDUSTRY AND ENVIRONMENT(TIE)

Abstract

TIE is an educational enrichment project for Missouri high school chemistry teachers that is the result of a cooperative effort by individuals from the Department of Chemistry and Physics at Central Missouri State University, the Chemical Council of Missouri and their prospective members, and the Missouri Department of Natural Resources in conjunction with the Missouri Department of Elementary and Secondary Education. It involved 73 teachers in a week-end workshop, meeting with chemists, engineers, and educators. Following the workshop the participants designed and developed a teaching packet or research project and participated in a Reporting Conference during which they reported on their packets or research projects.

The project was supported by the National Science Foundation, 27 chemical companies, the Chemical Council of Missouri, the Missouri DNR, and the Chemistry Department at CMSU. The objectives of TIE are to provide: (1) enrichment of the participants knowledge of the chemical industry of Missouri and of the Missouri DNR, (2) communication links for the teachers, industry representatives and the Department of Natural Resources, (3) enrichment opportunities regarding the applications of computers, (4) examples of laboratory activities and research projects that have shown promise, and (5) encouragement for each participant to structure part of their science classes to include: Missouri chemical industries, the DNR and their school's local environment.

There is ample evidence that the teacher participants have benefited from the Workshop, the development of either a teaching packet or research project and the sharing at the Reporting Conference. Probably the single most exciting unanticipated outcome of the TIE experience is the desire of other states to host their own Teacher, Industry and Environment Workshop.

TEACHER, INDUSTRY AND ENVIRONMENT

BACKGROUND

The third Teacher, Industry and Environment(TIE) project was directed to certified career teachers of Chemistry in the high schools of Missouri. Missouri has about 450 schools teaching at least one unit of high school chemistry(1). The project emphasis was on assisting these teachers in the use of resources beyond the standard textbook. Many of the estimated 500 chemistry teachers are well qualified academically but have had little opportunity in recent years to enrich their teaching through contact with the various professional chemistry personnel working in Missouri(2)(3).

Missouri is rich in human resources, including many individuals involved in chemical research and product design and manufacture for business, industry and government. This project is an effort to provide a mechanism whereby these individuals and the agencies they represent can be organized into a working group for the purpose of improving what happens in the chemistry classrooms of Missouri high schools.

The project is directed to the interfaces identified by Broudy, Jacobson, Hurd and others during the sixties and seventies(4)(5)(6). These interfaces are evident from the priorities for science education as identified by Hurd more than a decade ago.(7)

1. Science must be a viable strand in the education of every student.
2. Technological achievements with all their ramifications throughout modern society constitute a new priority in science teaching.
3. Science should be taught in a social context.

4. A priority for learning science in the 1970's[and the 1980's] is the formation of those values which may serve to convert knowledge into wisdom and make for responsible social action.

5. The science curriculum ought to prepare students to cope with a world of change.

6. The process of education should provide the student with skills and intellectual attitudes to understand the emerging world and to mediate the future; the priority becomes how best to teach and learn the future.

Recent publications and public out-crying about the problems of science and mathematics education in America contain the basic elements of Hurd's priorities(8)(9)(10). Teachers with years of experience and advanced degrees do not know what products and processes take place in the various chemical facilities in their home state.

The Pre-workshop Questionnaire for TIE-86 contained several items designed to determine if the participants were knowledgeable about the chemical companies in their geographical location and also knowledgeable about the products and processes used therein. Three specific items have been pulled from this questionnaire to illustrate the above point, and they are:

1. Of the approximately 24 member companies of the Missouri Chemical Council, how many can you name?

4. For any one of the member companies of the Missouri Chemical Council, how many industrial processes utilized by this company can you name?

5. Of the many products manufactured by the member companies of the Missouri Chemical Council, how many can you name?

Seventy-two percent(48/66) could name a maximum of only four of the approximately 24 member companies of the Missouri Chemical Council. Fifty-two percent(34/66) could not name one of the industrial processes utilized by any one of the member companies. Approximately one third, 34%(23/66), could not name one of the products manufactured by any one of the member companies. The member companies include for example, Dow, Monsanto, American Cyanimid, DuPont and Mobay Corporation; well-known firms not only located in Missouri, but with nationwide facilities.

Prior to the first T.I.E. Workshop it was suspected that, in addition to the above, few of the teachers had any first hand knowledge of the activities within the government agencies such as the Missouri Department of Natural Resources. Conversations with the first TIE Workshop participants substaniated this suspicion.

In addition to questions to solicit whether or not the participants of TIE-86 were knowledgeable about the chemical industry of Missouri, they were also asked about the organization and operation of the Missouri Department of Natural Resources. Three items have been pulled from the TIE-86 Pre-workshop Questionnaire to illustrate the participants knowledge and utilization of the Missouri DNR, and they are:

6. Of the five divisions of the Missouri Department of Natural Resources, how many can you name?

7. Of the five policy making commissions assigned to the Division of Environmental Quality, how many can you name?

8. How many times have you contacted the Environmental Education Specialist at the Missouri Department of Natural Resources for assistance in your classroom teaching?

Fourty-three percent(28/66) could not name any one of the five divisions of the Missouri DNR. Eighty-six percent(56/66) could not name any one of the five policy making commissions assigned to the Department of Environmental Quality which operate within the DNR. Only 3 of the 66 questionnaire respondents had contacted the Environmental Education Specialist at the Missouri Department of Natural Resources more than 4 times for assistance in their classroom teaching.

Examination of the requirements for teacher certification and the test items of the National Teachers Examination reveal that these priorities for science education, mentioned above, continue to be largely ignored by those preparing and certifying teachers. This project is designed to bring the forces of industry, environment and education into a communications network with high school teachers in an effort to provide a base from which teaching changes can be realized.

The T.I.E. Projects are bringing product providers, environment protectors and academicians together in an effort to help teachers relate and update their instruction. The project description is divided into six phases:

PHASE ONE - ORGANIZATION AND PLANNING OF THE PROJECT

PHASE TWO - PARTICIPANT SELECTION

PHASE THREE - THE INTERFACES WORKSHOP

PHASE FOUR - THE CHEMISTRY-ENVIRONMENT TEACHING PROJECT

PHASE FIVE - REPORTING CONFERENCE

PHASE SIX -THE PROJECT EVALUATION

PHASE-ONE: ORGANIZATION AND PLANNING OF THE PROJECT

The planning phase of this project was an indispensable series of meetings between members of the industrial team, Department of Natural Resources, area chemistry teachers on the planning committee and the project directors.

Members of the TIE-87 Planning Committee included:

Duane Barnes	Dow Chemical Company
Elmer Boehm	Monsanto Industrial Chemical Co.
Dr. William Boulter	Science Consultant DESE
Howard(Gene) Cornell	Chemistry Teacher, Sherwood R-VIII
James Downes	Monsanto Industrial Chemical Co.
Ms. Mary Harris	John Burrough School
Dr. Neal Holmes	Professor of Science Ed., CMSU
George F. Lewenczuk	American Cyanamid
Ms. Elaine Osborne	Mobay Corporation
William Palmer	Missouri DNR
Dr. Michael H. Powers	Associate Professor of Chem., CMSU
Marc W. Romine	Science Teacher, Russellville H.S.
Steve Schnieder	Environ. Educ. Spec., Missouri DNR
Mrs. Marie Sherman	Chemistry Teacher, Ursuline Academy
Robert D. Suits	Chemistry Teacher, Hickman H.S.

The planning sessions dealt with program design and presenters, public relations, statewide teacher notifications and participant selection, including funding committments by individual chemical company sponsors.

PHASE-TWO: PARTICIPANT SELECTION

Examination of the data comparing locations of schools and the various chemical companies of Missouri reveals that the companies are largely located near the two major metropolitan areas of Kansas City and St. Louis. It had been hoped that a direct matching of teachers and companies would be possible but the distances between teachers and companies would not allow such a selection process.

Examination of the number of schools versus student population, students versus student population per school, number of chemical companies versus average student population, and number of teachers versus student population per school, indicate that a matching of chemical companies and chemistry teachers would not give the selection process the coverage that was desired. It was decided that the teachers would be selected based on the number of students per school. Non-public schools would be considered in the same manner as the public schools.

Each high school principal was notified by letter and publicity brochure of Project T.I.E. They were asked to provide the name of a candidate teacher to the Chemical Council Selection Committee. The committee selected participants at random within each student population interval or class. The number of participants depended upon funding available with a present target population of about 70 teachers.

PHASE THREE: THE INTERFACE WORKSHOP

The interface workshop was held in late February 1987. This date allowed the teacher participants sufficient time during the remaining three months of the Spring semester to make use of the workshop resources in their classrooms and to complete the Industry/Environment Teaching/Research Project. Each participant could enroll in Special Problems in Chemistry(Chem 4911) for two(2) semester hours of graduate credit from Central Missouri State University. Successful completion of a resource teaching packet or a research project involving industrial chemistry and/or the environment was expected by the Spring Reporting Conference proposed for May 1987.

The workshop staff involved professional chemists and engineers from the Missouri Chemical Council, environmental quality personnel from the Department of Natural Resources, members of the Central Missouri State University Chemistry Department and senior teachers from several Missouri high schools.

The workshop is structured around seven basic goals. These goals are, To provide:

1. Enrichment of the participants knowledge of the Chemical Industry of Missouri - their products, plants and processes.
2. Communication links for the teacher and industry through personal contact.
3. Enrichment of the participants knowledge of the Missouri Department of Natural Resources and it's functions.
4. Communication links for the teacher and the Department of Natural Resources through personal contact.
5. Enrichment opportunities regarding the applications of computers to: (a) Learning through the use of existing programs and (b) Collecting and processing data by interfacing methods.
6. Examples of laboratory activities and research projects that have shown promise for high school chemistry students involving the environment.
7. Encouragement for each participant to structure some part of their chemistry instruction to include; Missouri chemical industries, The Department of Natural Resources and their own local environment.

Housing and workshop sessions were at the Ramada Inn, Jefferson City, Missouri. The following agenda was approved for TIE-87(Spring 1987).

TEACHERS, INDUSTRY, AND THE ENVIRONMENT WORKSHOP AGENDA

THURSDAY, FEBRUARY 26, 1987

6:00 p.m.,	Registration	Lobby
	Mixer, featuring displays by Missouri Chemical companies, Department of Natural Resources and CMSU.	Stratford Room

FRIDAY, FEBRUARY 27, 1987

a.m. 7:00- 7:45	Continental Breakfast	Roanoak Room
7:45	Registration	Hermitage Room
8:00	Introduction and Opening Remarks	Dr. Neal Holmes Central Missouri State Univ. George F. Lewenczuk American Cyanamid Steve Schnieder Department of Natural Resources Walter Bivins Dow Chemical
8:30	Keynote Address:	Tom Smolarek Eastern Division General Manager Dow Chemical Co.
9:30	Break	
10:00	Industry Breakout Sessions (Sessions will be repeated)	Hermitage Room
	The Applications of Chemistry in the Grocery Store	G. Douglas Nelson Monsanto Company
	Demonstration of Analysis of Plant Constituents	Karen Pither Mobay Corporation
	Thin Layer Chromatography	Nancy Luxton Syntex Agri Business Inc.
	Modern Environmental Controls	J. Brad Willett American Cyanamid
Noon	Lunch	Roanoak Room
p.m. 1:00	p.m., Luncheon Address:	Dr.Edwin M. Kaiser University of Missour-Columbia

FRIDAY, FEBRUARY 27, 1986

p.m.		Hermitage Room
1:30	Interpretation: Technique in Teaching Environmentally	Steve Schneider Environmental Education Spec. Department of Natural Resources
3:00	Chemistry Data Acquisition Activities	Hermitage Room
	Blue Group Simplified Titration and Some Applications	Marie Sherman Chemistry Teacher Ursuline Academy, St. Louis
	Green Group Water Quality Activities and Projects	Gen Cornell Chemistry Teacher Sherwood R-VIII, Clinton
	Red Group Colorimetric Methods and Applications	Bob Suits Chemistry Teacher Hickman H.S., Columbia
	Yellow Group Microcomputer Based Laboratories	Carol Thieman Chemistry Teacher Knob Noster H.S.
5:30	**Break**	
6:30	**Dinner**	Roanoak Room
	Dinner Address: Resource Recovery	Sandy Custard Recycling Coordinator Regional Recycling Program Mid-America Regional Council
8:00	**Chemistry Fair!** A Chemistry Potpourri	Hermitage/Roanoak Room

SATURDAY, FEBRUARY 28, 1987

a.m.		
8:00	Session Convenes	Hermitage Room
8:15	The DNR Laboratory	Jim Long, Director Laboratory Services Program Department of Natural Resources
9:00	Tour of DNR Labortory	
10:30	Evaluation Session	Hermitage Room
11:00	Wrap-up Session	Dr. Mike Powers CMSU

Personnel for the various sessions were provided by the member companies of the Missouri Chemical Council, the Department of Natural Resources and Central Missouri State University. Senior teachers, individuals that are not participants, were used as group leaders for the "hands on" sessions during the Workshop and as reporting group moderators for the Reporting Conference.

Support for the Teacher-Industry-Environment Workshop has and continues to be very strong from academic, governmental and industrial institutions. Support specifically allocated by the Missouri Chemical Council and its prospective members amounted to $16,500 and represents about 34% of the estimated cost of the planning meetings, workshop and reporting conference. A significant amount of additional support, which is not evident from budget reports or is not explicitly mentioned elsewhere, comes from industrial firms and the DNR in terms of personnel costs, computer time, mailing expenses, displays, travel, meals and lodging. Some support for TIE-86 by Missouri industrial firms and the Missouri DNR has been generally unreported by virtue of donations. Such unreported support amounted to $11,790 and represents about 24% of the estimated cost of TIE-87, assuming other amounts remain constant. Therefore, the industrial and state governmental components of T.I.E. support about 58% of the total estimated cost. Fourty-two percent represents a decrease of 3% in the support requested from NSF for TIE-87 comparted to TIE-86.

PHASE FOUR: THE CHEMISTRY - ENVIRONMENT TEACHING PROJECTS

This part of the project was the responsibility of the participating teachers and took place in the time between the Workshop and the Reporting Conference. Each teacher was encouraged to use imagination and creativity in the selection and development of the teaching packet or research project. Project reports were shared and discussed at the reporting conference. A final collection of all project abstracts, the TIE Field Book, was mailed to each participant during the summer or fall of 1988, as was done for TIE-86. A major part of the grade for Chemistry 4911 was based on the project reports. If a participant enrolled for graduate credit, attended the Workshop, developed a project and reported on that project at the Reporting Conference, the maximum grade was an A. If a participant completed all of the above mentioned tasks, but submited a paper rather than attended the Reporting Conference, the maximum grade was a B. If the participant enrolled for graduate credit and attended the Workshop only, then the maximum grade was a C.

Samples of the topics for teaching packets or research projects chosen by the TIE-86 participants included:

Slide Show of Community Chemical Applications
Acid Rain
Analysis of NaCl in Snack Foods
Transportation of Chemicals Safely
Soil-Its Characteristics and Quality
The Effect of Emulsifiers on Process Cheese
Determination of the Percent Chromium in Razor Blades

PHASE FIVE - THE EVALUATION AND REPORTING CONFERENCE

The T.I.E. staff and teacher participants met in May 1987 on the campus of Central Missouri State University to listen to and videotape reports from the teacher participants and to give them their teaching project evaluation reports. The teachers were divided into four sections with approximately 18 teachers in each section. Each participant had twenty minutes to present their packet or research project and ten minutes to respond to questions. Dr. Holmes, Dr. Powers and teacher consultants served as group leaders. Since time did not permit all participants to observe all reports, video tapes of all sessions were made available for the participants who wished to see the reports of others, as was done for TIE-86.

PHASE SIX: THE PROJECT EVALUATION

Each participant was asked to evaluate the T.I.E. project and a compilation of these evaluations formed a major part of the project evaluation. An evaluation questionnaire was used following the TIE-85 and TIE-86 workshops. The participants were asked to "grade" twenty aspects of the workshop with either an A, B, C, D or F. The questionnaires were scored by assigning points to the "grades" such as A=4, B=3, C=2, D=1 and F=0. A grade on a scale of 4 to zero was calculated for each of the twenty items.

If the aspects of the workshop evaluated are grouped according to the type of presenter, i.e., professional teacher(items 8,9,10,11,14,16), industry person(items 2,3,4,5,6,7) and enviornmental person(items 12,15), the cummulative "grade point averages" were 3.30, 3.55 and 3.45, respectively. Whether or not these G.P.A.'s are statistically different or not has not been determined.

However, these data do seem to indicate that the participants tend to favor the involvement of the persons from the industrial component. A possible reason for this outcome might be because the industry persons present material which is most unfamilar to the participants, whereas the material presented by the professional educators is more familar and, hence, the participants are more critical. The interpretation is open to debate, in part due to the limited amount of data collected.

A fourth catagory, namely, Workshop Environment(items 1,13,17,18,19) received a G.P.A. of 3.56, the highest of the four catagories. In addition, all of the participants responded affimatively when asked if they would favor having other workshops of this type for teachers that were not selected as participants for TIE-87. Similar results were obtained for TIE-85 and TIE-86.

In order to assess whether or not the goals of the workshop have been achieved, all workshop participants were required to complete a Pre-workshop Questionnaire. Following the workshop the participants were administered a Post-workshop Questionnaire. An analysis was conducted to determine whether or not a significant change had transpired.

To assess whether or not the goals of T.I.E. were achieved, a comparison was made of the Pre- and Post-workshop Questionnaire responses. An example of this comparison is provided in the following paragraph.

One of the goals for T.I.E. is to provide enrichment of the participants knowledge of the chemical industry of Missouri, their products, plants and processes. Items one, two and four on the questionnaires were designed to measure changes in this catagory registered by the participants. The following table lists the responses by percentage for the pre- and post-questionnaire responses to Item Number 1(Of the approximately 24 member companies of the Missouri Chemical Council, how many can you name?)

Response Catagory	Pre-Workshop Percentages	Post-Workshop Percentages
0-4	72	9
5-9	23	65
10-14	5	21
15-19	0	3
20-24	0	0
		(2% no response)

Prior to the workshop, 72% of the participants could identify a maximum of only 4 member companies of the Missouri Chemical Council. Following the workshop, 65% could name as many as 9 of the member companies. Similar positive results were achieved for each of the other six goals. In addition, the evaluation of the teaching packets and the research projects designed and implemented by the participants constituted a significant part of the determination of whether or not the goals of the workshop were achieved.

In part to assess the effectiveness of the Reporting Conference to facilitate the achievement of the goals for T.I.E., a Post-reporting Conference Questionnaire was given to the teacher participants.

One of the several items on the questionnaire asked the respondent to indicate the number of presentations made in their group for which they would request additional materials or information. This relates specifically to Goals 6 and 7(see page 7). The following table summarizes the results of this particular post-reporting conference questionnaire item.

Response Catagory	Percent Response
None	2
1-3	40
4-6	46
7-9	6
>9	6

As the above table indicates most of the teachers participating in the Reporting Conference(98%) observed one or more examples of laboratory activities or research projects involving the environment and/or the chemical industry which they recognized as promising for their students.

Several sources of information are available for assessing the effectiveness of the Workshop and Reporting Conference activities in achieving the goals set forth previously. Formal assessment items include the Pre and Post-workshop Qustionnaires, the Workshop Evaluation "grade" report and the Post-Reporting Conference Questionnaire. In addition each of the above formal insturments requested anecdotal comments from the participants. Hundreds of anecdotal comments continue to be very helpful in assessing the effectiveness of the Worshop activities and any follow-up involvement, as well as, aiding the planning and execution of future Teacher, Industry and Environment projects.

Another good evaluation indicator is the level of support provided by the various contributors to the TIE Project. Support for the Teacher-Industry-Environment Workshop has and continues to be very strong from academic, governmental and industrial institutions, as well as individuals. These individuals include representatives from the Chemical Council of Missouri, the Missouri Department of Natural Resources and Central Missouri State University.

Perhaps the commitment of the Missouri chemical industry, particularly the Chemical Council of Missouri to continue support of TIE was best expressed by George Lewenczuk, Chairman of the Education Committee of the Council, when he said in his letter of 9 January 1987, "We[the Council] are planning to continue our effort to provide high school chemistry or science teachers the opportunity to work with industrial chemists and chemical engineers. We want to continue in creating partnership between educators and the chemical industry across the state of Missouri by continuing the TIE program."

The above are but a few examples of the evaluation phase of the TIE Project. The following pages describe in detail all of the evaluation instruments used and provide details of the responses provided by the teacher participants from the 1987 Teachers, Industry and Environment Workshop and Reporting Conference.

Evaluation Instruments:

Five instruments were designed to evaluate the workshop and the teacher participants. These instruments included: (1) the TIE Workshop Grade Report, (2) the Pre-Workshop Questionnaire, (3) the Post-Workshop Questionnaire, (4) the Reporting Conference Questionnaire, and (5) the TIE Participant Survey. The purpose of each of the above instruments was to evaluate the efforts of various contributors to the total learning system, as well as, to determine how effectively the Project accomplished the seven goals expressed previously. Application of these instruments and results obtained therefrom are detailed in the sections to follow.

Results:

TIE Workshop Grade Report

The Workshop Grade Report asked participants to grade nineteen aspects of the workshop with either an A, B, C, D or F. The Grade Reports were scored by assigning points to the "grades," i.e., A=4, B=3, C=2, D=1 and F=0. A grade on a scale of 4 to zero was calculated for each of nineteen items. The questionnaire and the detailed results of the analysis are shown in Appendix I. If the aspects of the workshop evaluated are grouped according to the type of presenter, i.e., professional teacher(items 7, 9, 10, 11 and 12), industry person(items 2, 3, 4, 5 and 6) and environmental person(items 8, 13, 15 and 16), then the following table results.

Table I.

Professional Teacher	Industry Person	Environmental Person
3.75	2.80	2.72
3.70	3.69	3.42
3.17	3.31	3.20
3.28	3.62	3.25
3.72	3.18	
<3.52> Mean	<3.32> Values	<3.15>

These results differ from those for TIE-86 in which the mean GPA's of 3.30, 3.55 and 3.45 were observed for the professional teacher, industry person and environmental person, respectively. For TIE-87 the mean GPA's, although different, are not statistically different as determined by a one-way analysis of variance treatment. The results of the ANOVA treatment are shown in Appendix I.

A fourth catagory, Workshop Environment, included items 1, 17, 18 and 19 on the Grade Report. A mean GPA of 3.44 was calculated for this catagory. In addition the Workshop Grade Report asked the teacher participants to respond to three questions listed as 20, 21 and 22 on the response form(see Appendix I). An unedited compilation of the written comments are contained in Appendix I. In general, all of the participants responded affirmatively when asked if they would favor having other workshops of this type for teachers that were not selected as participants for TIE-87. Similar results were obtained for previous TIE workshops.

Pre- and Post-Workshop Questionnaires

In order to assess whether or not the goals of the workshop were achieved, all workshop participants were required to complete a Pre- and Post-Workshop Questionnaire as shown in Appendix II. A comparison was made between the responses of these questionnaires.

Goal 1 was to provide enrichment of the participants knowledge of the chemical industry of Missouri, its products, plants and processes. Items one, two and four(one, two and five on the Post-Workshop Questionnaire) were designed to measure possible changes registered by the participants. The following table lists the responses by percentage for the Pre- and Post-Questionnaire responses to Item 1; "Of the approximately 24 member companies of the Missouri Chemical Council, how many can you name?"

Table II.

Response Catagory	Item 1 Pre-Workshop Percentages	Item 1 Post-Workshop Percentages
0	11	2
1-4	66	8
5-9	21	46
10-14	2	36
15-19	0	8
>19	0	0

Prior to the workshop, 77% of the participants could identify a maximum of only 4 member companies of the Missouri Chemical Council. Following the workshop, 46% of the participants could name as many as 5 companies and 36% could name as many as 10 member companies of the Missouri Chemical Council.

The following table lists the responses by percentage for the Pre- and Post-Questionnaire responses to Item 2; "Of the companies involved in the Missouri chemical industry in your vicinity, to how many have you taken(would you consider taking) your class on a fieldtrip?"

Table III.

Response Catagory	Item 2 Pre-Workshop Percentages	Item 2 Post-Workshop Percentages
0	85	8
1	9	23
2	4	34
3	0	20
4	0	7
>4	2	8

As shown in the above table, 85% of the participants had never taken their chemistry class on a fieldtrip to a chemical industry in the vicinity of their school. However, after the Workshop 77% of the participants would consider taking their chemistry classes on a fieldtrip to at least one chemical industry in their vicinity and 20% to as many as three.

The following table lists the responses by percentage for the Pre- and Post-Questionnaire responses to the question; "Of the many products manufactured by companies involved in the Missouri chemical industry, how many can you name?"

Table IV.

Response Catagory	Item 4 Pre-Workshop Percentages	Item 5 Post-Workshop Percentages
0	44	0
1	24	0
2	16	2
3	5	8
4	6	16
>4	5	74

Prior to the Workshop nearly one-half(44%) of the participants could not name one product manufactured by the Missouri chemical industry. Following the Workshop nearly three-fourths(74%) of the participants could name more than four products and all participants could name at least one product manufactured by the Missouri chemical industry.

Goal 2 was to provide communication links for the teacher and industry representative through personal contacts. Item 3 on the Pre- and Post-Workshop Questionnaire was designed to measure possible changes registered by the participants. The following table lists the responses by percentage for the Pre- and Post-Questionnaire responses to Item 3; "Of the companies involved in the Missouri chemical industry, how many individuals within these companies would you feel comfortable contacting for assistance with your classroom teaching?"

Table V.

Response Catagory	Item 3 Pre-Workshop Percentages	Item 3 Post-Workshop Percentages
0	44	0
1	25	8
2	18	15
3	0	25
4	6	17
>4	7	35

As shown in the above table nearly one-half of the participants would not feel comfortable contacting even one individual from industry to assist with their classroom teaching prior to the Workshop. Following the Workshop all of the respondants felt comfortable contacting at least one industrial person and over 90% felt comfortable contacting two or more to assist with their classroom teaching.

Goal 3 was to provide enrichment of the participants knowledge of the Missouri Department of Natural Resources and it's functions. Item 6 of the Pre-Workshop Questionnaire asked, "Of the five divisions of the Missouri Department of Natural Resources, how many can you name?" Item 7 of the Pre-Workshop Questionnaire asked, "Of the five policy-making commissions assigned to the Division of Environmental Quality, how many can you name?"

The results of the Pre-Workshop Questionnaire Items 6 and 7 indicated that the participants knowledge in this regard was lacking. The following tables show the results from the Pre-Questionnaire.

Table VI.

Response Catagory	Item 6 Pre-Workshop Percentages	Item 7 Pre-Workshop Percentages
0	44	78
1	31	11
2	11	7
3	9	2
4	0	2
>4	5	0

As the above table indicates nearly one-half(44%) of the workshop participants could not name one division of the Missouri DNR and over three-fourths(78%) could not name one of the five policy making commissions of the Missouri DNR. Althouth this lack of knowledge probably does not have a serious effect concerning the teaching expertise of the workshop participants, it does indicate a lack of knowledge of the structure of the Missouri DNR.

Of a more serious concern is the workshop participants utilization of the Environmental Education Specialist at the Missouri DNR. Goal 4 was to provide a communication link for the teacher and the Missouri DNR. Items 8 and 5 on the Pre- and Post-Workshop Questionnaires, respectively, addressed this goal. Item 8 asked, "How many times have you contacted the Environmental Education Specialist at the Missouri DNR for assistance in your classroom teaching within the past 5 years?" Item 5 asked, "As a result of this workshop[TIE-1987], how many individuals from the Missouri DNR would you feel comfortable in contacting to obtain help with your classroom teaching?" The following table summarizes the results for Items 8 and 5.

Table VII.

Response Catagory	Item 8 Pre-Workshop Percentages	Item 5 Post-Workshop Percentages
0	83	2
1	8	11
2	6	23
3	1.5	20
4	1.5	20
>4	0	24

As the above table indicates, over eighty percent(83%) of the workshop participants had not contacted the Environmental Education Specialist in the previous five years. Following the workshop 98% of the participants indicated that they would feel comfortable contacting at least one person from the Missouri DNR. Nearly one-fourth(24%) indicated that they would feel comfortable contacting more than four people associated with the Missouri DNR for help with their classroom teaching. Since the Missouri DNR has only one Environmental Education Specialist, the results indicate that a communications link was established between several individuals from the Missouri DNR and the workshop participants.

Goal 5 was to provide examples of computer activities for learning through the use of existing programs and collecting and processing laboratory data by computer interfacing methods. The Pre-Workshop Questionnaires for TIE from 1985 through 1988 were quite revealing concerning the participants knowledge and application of microcomputers in the science classroom. The following table summarizes the responses to the questions shown for four groups of participants. Values in the table represent percentages of those responding to the questions.

TIE Participating Teachers
Computer Application Survey Results
1985-88

1. Do you have at least one microcomputer available for use in your laboratory teaching?

Year	Yes	No	N/A
1985	81	19	0
1986	80	19	1
1987	70	30	0
1988	77	21	2

2. Do you use microcomputers in your chemistry teaching?

Year	Yes	No	N/A
1985	55	43	2
1986	47	48	5
1987	38	58	4
1988	45	51	4

3. Do you have a working knowledge of the programming language BASIC?

Year	Yes	No	N/A
1985	62	38	0
1986	45	52	3
1987	43	57	0
1988	51	45	4

4. Do you do any programming in BASIC related to your chemistry teaching?

Year	Yes	No	N/A
1985	33	64	3
1986	13	82	5
1987	11	87	2
1988	9	87	4

5. Do you use microcomputers as a measuring or data logging device in your laboratory?

Year	Yes	No	N/A
1985	14	84	2
1986	11	86	3
1987	13	85	2
1988	23	70	7

6. Do you use non-commercial devices for laboratory interfacing projects?

Year	Yes	No	N/A
1985	10	90	0
1986	6	82	12
1987	13	81	6
1988	13	74	13

7. Have you ever attended a workshop concerned with the interfacing of transducers with microcomputers?

Year	Yes	No	N/A
1985	17	80	3
1986	17	82	1
1987	23	77	0
1988	17	81	2

The responses of the four groups are quite consistent, with perhaps the exception of Question 4 which shows a decreasing trend in those who do programming in BASIC related to their chemistry teaching. The majority of all groups, approximately 80%, have access to at least one microcomputer for use in their laboratory teaching. However, only about 50% actually use them in teaching chemistry and fewer than 15% are using a microcomputer as a measuring or data logging device.

Whether or not TIE-87 was successful in altering the participants use of microcomputers in their teaching strategies was not determinable from the Post-Workshop Questionnaire. However, Item 8 on the Post-Workshop Questionnaire did address the efforts of the workshop staff to achieve **Goal 5** by asking, "How many ideas for classroom activities have you obtained from this workshop[TIE-87] which relate to computer applications?" The following table summarizes the responses to Item 8.

Table VIII.

Response Catagory	Item 8 Post-Workshop Percentages
0	0
1-4	61
5-9	33
10-14	1.5
15-19	1.5
>19	3

All of the workshop participants indicated that they had obtained at least one idea concerning the application of microcomputers to their classroom teaching. Additional information pertaining to this issue will be presented later in this report.

Goal 6 of TIE-87 was to provide examples of laboratory activities and research projects that have shown promise for junior/senior high school students of chemistry involving industry and/or the environment. Item 9 on the Pre-Workshop Questionnaire asked the participants to indicate how many of their chemistry course activities specifically involved the Missouri chemical manufacturers and their products. The results shown in the following table indicate that nearly two-thirds(64%) used no activities related to the Missouri chemical manufacturers or their products.

Table IX.

Response Catagory	Item 9 Pre-Workshop Percentages
0	64
1-5	27
6-10	2
11-15	2
>15	2

Item 6 on the Post-Workshop Questionnaire was designed to assess the achievement of **Goal 6** by asking, "How many ideas for classroom activities have you obtained from this workshop[TIE-87] which relate to industrial applications?" The following table summarizes the responses of the teacher participants following the workshop.

Table X.

Response Catagory	Item 6 Post-Workshop Percentages
0	0
1-4	20
5-9	38
10-14	21
15-19	10
>19	11

The above table indicates that all of the participants were able to glean at least one idea that showed promise for use with their students involving industrial applications.

Item 10 on the Pre-Workshop Questionnaire asked the participants to indicate how many of their chemistry course activities deal specifically with the quality of the Missouri environment. The results shown in the following table indicate that over one-third(39%) used no activities related to the quality of the Missouri environment.

Table XI.

Response Catagory	Item 10 Pre-Workshop Percentages
0	39
1-5	57
6-10	2
11-15	0
>15	0
N/R	2

Item 7 on the Post-Workshop Questionnaire was designed to assess the achievement of **Goal 6** by asking, "How many ideas for classroom activities have you obtained from this workshop[TIE-87] which relate to environmental applications?" The following table summarizes the responses of the teacher participants following the workshop.

Table XII.

Response Catagory	Item 7 Post-Workshop Percentages
0	0
1-4	18
5-9	48
10-14	23
15-19	7
>19	4

The table shown above indicates that all of the participants were able to glean at least one idea that showed promise for use with their students involving the quality of the Missouri environment.

Goal 7 for TIE-87 was to provide encouragement for each participant to structure some part of their chemistry instruction to include: the Missouri chemical industries, the Missouri Department of Natural Resources and the participants local environmental quality. Certainly the workshop staff provided encouragement to the participants to structure a part of their chemistry classroom activities around industrial and/or environmental applications. The extent to which this encouragement was effective has not been accurately measured. However, there are some indicators that reflect the effectiveness. Fifty-one participants enrolled in Special Problems in Chemistry at Central Missouri State University in order to receive graduate credit for TIE-1987. Of those receiving graduate credit twenty attended the Workshop, completed a special problem or research project and attended the Reporting Conference to report on their efforts. The 30 projects submitted have been distributed within six catagories as shown in the following table.

Table XIII
Participant Project Summary

Catagory	Number of Projects	Catagory Percentages
Environmental	11	37%
Industrial	1	3
Pure Chemistry	5	17
Consumer Chem.	7	23
Chemical Safety	3	10
Non-Chemistry	3	10
Totals>	30	100%

As can be seen from the above table, the largest catagory contained projects concerning the environment and nearly one-half(40%) of the projects were either oriented toward industrial or environmental applications.

The situation as a whole could have been better if more participants had followed through and completed projects and, in addition, if more of the completed projects were oriented toward environmental and industrial applications. The most probable reason for the apparent lack of participation in the Reporting Conference was that it occured during Memorial Day weekend. This would appear to be poor planning, if it were not for the fact that the Workshop participants voted for the date on which the Reporting Conference would be held.

Reporting Conference and Questionnaire

Of the 73 TIE-87 Workshop participants(see Appendix V), 51 enrolled for the available graduate credit. Of the 51 that enrolled, 20 attended the Workshop, completed a teaching packet or research project and reported on their accomplishments at the Reporting Conference. The Reporting Conference was a one-day meeting on the campus of Central Missouri State University held approximately three months following the Workshop. Those attending gave a 10 to 20 minute oral presentation and demonstration concerning their teaching packet or research project that resulted from attending the 1987 Workshop.

The purpose of the Reporting Conference Questionnaire(see Appendix III) was to assess the effectiveness of the Reporting Conference and the overall effectiveness of the **Teachers, Industry and Environment Workshop** experience.

Of those responding to the Reporting Conference Questionnaire, 37% indicated that it was the most important workshop activity, while 63% indicated that it was important, but not essential. When asked, "What was the most positive aspect of the Reporting Conference?", most of the respondants indicated that the fellowship with other teachers and the sharing of ideas was the most important.

When the participants were asked to indicate the importance of the Reporting Conference in helping them structure part of their chemistry/science classes to include the Missouri chemical industry, the Missouri DNR and their school's local environment, 28% indicated that it was very important and 67% indicated that it was important, but not essential.

The Reporting Conference Questionnaire also asked the participants to rate the TIE Workshop(total program) on the basis of other inservice education experiences they had had. One-third indicated that it was the best they had ever attended, 50% indicated that is was better than most they had attended. One respondant indicated that TIE was similar to most of the inservice workshops they had attended and two respondants indicated that TIE was their first inservice experience. Other items on the Reporting Conference Questionnaire dealt more specifically with the execution of the Reporting Conference and these results are contained in Appendix III.

TIE Participant Survey

A survey was sent to all TIE participants for the years 1985, 1986 and 1987 to solicit their responses concerning the effectiveness of their TIE experience(see Appendix IV). Ninety-four teachers responded with nearly equal representation for each of the three years.

Several of the items in the survey are of interest with respect to the respondants awareness, attitude and the attainment of the Workshop goals. For example, Item 15 on the survey stated that "Missouri has more chemical industries than I thought," to which 83% of the respondants agreed or strongly agreed. This also relates to the attainment of **Goal 1**. Item 4 on the survey stated that "Since TIE I feel more comfortable talking to industry chemists," to which nearly 60% either agreed or strongly agreed. This also relates to the attainment of **Goal 2**. Item 2 stated "I got some good teaching ideas from the TIE Program," to which 99% agreed or strongly agreed. This is evidence that **Goal 6** was attained, i.e., the providing of examples of laboratory activities and research projects that have shown promise for junior/senior high school students.

Perhaps Items 3 and 11 and the responses thereto are as important as any of the other items in as much as they relate to the participants attitudes. Item 3 stated that "I believe the Missouri Chemical Council really cares about high school science teaching," to which 90% of the respondants either agreed or strongly agreed and 10% were neutral. Item 11 stated that "I would like to attend another TIE," to which 88% either agreed or strongly agreed and 10% were neutral.

Summary:

There are several indications that TIE is and has been successful for the workshop instructors, the TIE Planning Committee, the Missouri chemical industry, the Missouri Department of Natural Resources and above all the teacher participants.

Three industrial chemists representing Monsanto Corporation, Mobay Corporation and American Cyanamid participated as workshop instructors during the "industrial break-out sessions." Each were well received by the teacher participants and each have commented on how well they enjoyed the teachers and their enthusiasm. The representative from Monsanto, now retired, serves on the TIE Planning Committee and has been a regular participant since the inception of TIE. Four highly qualified secondary chemistry teachers participated as workshop instructors during the "teacher break-out sessions." As is usually the case, these individuals are those most readily received by the teacher participants as indicated on the TIE Workshop Evaluation. Three of these four individuals have served as workshop instructors for TIE from 1985 through 1988.

Probably the most successful aspect of TIE is the extensive planning carried out by the TIE Planning Committee. Each year the committee begins planning the February workshop in June of the preceeding year and meets monthly except for December. The committee is chaired by a member of the industrial community, usually a member of the Missouri Chemical Council. Sub-committees are setup for publicity, teacher selection, the workshop program, arrangement of physical facilities and budget.

In 1987 the TIE Planning Committee received the Resource Steward Award. This award is the highest award given by the State of Missouri and the Department of Natural Resources for "preserving and wisely using our priceless natural resources." This award, signed by the Governor of the State of Missouri and usually given to an individual, was, for the first time, given to a committee.

The Missouri chemical industry, particularly the Missouri Chemical Council, has from the inception of TIE graciously supported the concept and the reality of TIE. Each year their contribution to TIE increases. In 1988, when NSF funding ceased, the Missouri Chemical Council increased their contributions to compensate for much of the former NSF support. However, the Reporting Conference was not held and teacher participants were required to pay for optional graduate credit from Central Missouri State University due to lack of funding. In return for their contributions of money and "man-power", the chemical industry has made contact with approximately 250(through 1988) of Missouri's 600 secondary chemistry teachers. The number of students contacted through teachers from 1985-1988 can only be estimated. For example, the 94 teachers that responded to the TIE Participant Survey discussed earlier, reported they taught a total of 233 chemistry classes or about 2.5 classes per teacher. If this is true for the 250 TIE teacher participants, then for classes of 24 students each the chemical industry may have had an impact on 15,000 Missouri chemistry students.

All Pre-Workshop Questionnaires from 1985 through 1988 have indicated that the teacher participants have not been in contact with the Environmental Education Specialist of the Missouri Department of Natural Resources for help with their teaching and they have not included many course activities that deal specifically with the quality, or lack thereof, of the Missouri environment(see Appendix II). As a result of the TIE Workshop every teacher participant not only meets the DNR Environmental Education Specialist, but has the opportunity to hear and see his expertise in regard to the Missouri environment. In addition each teacher participant has the opportunity to meet other DNR officials and discuss various ideas concerning Missouri's environmental issues. The DNR distributes a variety of information to the teacher participants which ultimately ends up in the hands of students. The TIE Fieldbook contains many student activities, demonstrations and research projects that TIE participants have used in their chemistry classrooms with their students. Many of these activities are the direct result of the TIE Workshop and they deal directly with environmental issues pertainent to the state of Missouri(see Appendix IV).

The TIE-1987 teacher participants, as well as the other TIE participants, have benefited from the Workshop, their efforts to develop either a teaching packet or research project and the sharing at the Reporting Conference.

Evidence for this is contained within the responses to the formal evaluation instruments such as the Workshop Evaluation, the Post-Workshop Questionnaire, the Reporting Conference Questionnaire and the Participant Survey, as well as the many comments made by the teacher participants to the TIE Project staff(see Appendices I, II, III and IV). One of the unanticipated outcomes on the part of the TIE staff, particularly the Project Directors, is that the TIE Workshop and Reporting Conference has afforded the opportunity to observe and select future TIE instructional personnel. One of the workshop instructors for the "teacher break-out sessions" in 1987 was a 1986 teacher participant. In addition, one of the workshop instructors for the "teacher break-out sessions" in 1988 was a 1987 teacher participant. Both of these individuals became interested enough in TIE as a participant to be selected as a member of the workshop instructional staff. Other participants have expressed similar interests.

Probably the single most exciting unanticipated outcome of the TIE experience is the desire of other states to host their own Teachers, Industry and Environment Workshop. In 1986 a group from Tennessee attended the Workshop and subsequently hosted a TIE in their state the following year. Some of the Missouri TIE staff and Planning Committee helped with the Tennessee workshop. In 1987 a group from Delaware attended the Missouri Workshop and plan to hold a TIE in their state in the near future. Interest from other states such as Ohio and Texas has also been expressed. Perhaps it is true that "imitation is the sheerest form of flattery."

The desire by other states to implement a TIE type program is largely due to the efforts of Mr. Elmer Boehm, a founder of TIE in Missouri and a retired chemical engineer of the Monsanto Corporation. Mr. Boehm has taken the "TIE Story" to several states as indicated in the following table.

Table XIV
Dissemination and Outreach Activities

Date	Location	Event
Oct 1986	Wash. D.C.	National Chemical Manufacturers Assoc.
Nov 1986	Wash. D.C.	3rd Nat. Sym. on Partnerships in Ed.
Feb 1987	Nashville, TN	St. Bus. Allian. and Taxpayers Assoc.
Apr 1987	St.Louis, MO	Am. Inst. of Chemical Engineers Sym.
May 1987	St.Louis, MO	Parkway Parent Teachers Assoc.
Oct 1987	St.Louis, MO	Monsanto Fund Meeting
Nov 1987	Wash. D.C.	4th Nat. Sym. on Partnerships in Ed.
Feb 1988	Wilmington, DE	Delaware Chemical Industry Council

Additional outreach activites are planned for 1988 including the Science Teachers of St. Louis and the Fifth National Symposium on Partnerships in Education.

There is more than ample evidence that considerable support by and collaboration with appropriate constituencies, agencies and organizations exists. Probably the best example of collaboration is the composition of the TIE Planning Committee. The following table summarizes the composition of the Committee by listing their names, position within their respective organizations and their organization affiliation.

Table IX
The 1987 TIE Planning Committee

Name	Position	Affiliation
Duane Barns	Safety/Environ. Man.	Dow Chemical Co.
Walt Bivins	Chemical Engineer	Dow Chem. Co.
Elmer Boehm	Emergency Response Man.	Monsanto Co.
Dr. Wm. Boulter	Science Consultant	MO DESE
Gene Cornell	Chemistry Teacher	Sherwood R-VIII
Mary Harris	Chemistry Teacher	John Burroughs
Dr. Neal Holmes	Professor, Sci. Ed.	CMSU
George Lewenczuk	Manager, SPC & E	Amer. Cyanamid
Elaine Osborne	Public Relations, Man.	Mobay Corp.
Bill Palmer	Dir., Public Inform.	MO DNR
Dr. Mike Powers	Assoc. Prof. Chem.	CMSU
Steve Schneider	Envir. Ed. Specialist	MO DNR
Marie Sherman	Chemistry Teacher	Ursaline Acad.
Bob Suits	Chemistry Teacher	Hickman H.S.

An example of support by appropriate constituencies, agencies and organizations is the direct and indirect monetary suppport by the industrial component, particularly the Chemical Council of Missouri. The direct support by the industrial component for TIE-87 was $17,551.12. This amount does not include unreported support estimated in the grant application to be about $12,000 for TIE-86. This estimated unreported support is in all probability an underestimate since it does not include the expenses of the Eastern Division General Manager of Dow Chemical Company who gave the keynote address, company displays that cost over $2000 to transport and manage, and other unseen costs. A conservative estimate of the total reported and unreported costs to the industrial supporters is about $35,000. The figures listed above do not include direct and indirect costs covered by the Missouri Department of Natural Resourses which has assumed most of the expense of publicity and printing, as well as considerable manpower.

Teachers, Industry and Environment was conducted in 1988 and plans are currently underway for the 1989 version. Without NSF funding the Reporting Conference was not conducted following the 1987 workshop and it is not planned for 1989. The members of the Planning Committee believe that the Reporting Conference plays a vital role in the total TIE program, but efforts to date to find adequate and alternate funding have not been successful.

The TIE Planning Committee would like to express their collective appreciation to the National Science Foundation for its support (Grant TEI-8650101), without which the **Teacher, Industry and Environment Project** could not have achieved as much as it has.

REFERENCES CITED

1. King, Richard. "Missouri Science Education Assessment." Paper presented to the Science Teachers of Missouri, Lebanon, Missouri, May, 1984.

2. Helgeson, Stanley L., et al. "The Status of PRE-College Science, Mathematics, and Social Science Education: 1955-1975 Volume I. Science Education." Center for Science and Mathematics Education The Ohio State University, 1977.

3. Grifford, Bernard R. "Addressing the Needs in Precollege Mathematics and Science Education." Briefing of the Home of Representatives Democratic Caucus, April 27, 1983.

4. Broudy, H.S. "Can Research Provide a Rationale for the Study of Science?" Journal of Research in Science Teaching, 10(3):227-233, 1973.

5. Jacobson, Willard J. "Forty Years of Research in Science Education." Paper presented to the 47th annual meeting of the National Association for Research in Science Teaching, Chicago, Illinois, April 1974.

6. Hurd, Paul DeHart. "Futuring' about Science Teacher Education." Science Education, 57(4):517-519, 1973.

7. Hurd, Paul DeHart. "Emerging Perspectives in Science Teaching for the 1970's." Paper presented at the School Science and Mathematics Association annual meeting, Detroit, Michigan, November, 1977.

8. O'Sullivan, P.S., et al. "A Model for the Effect of an In-Service Program on Junior High School Student Science Achievement." Journal of Research in Science Teaching, 18(3):119-207, May 1981.

9. Glass, Lynn W., "Business and Industrial Support of High School Science Education." School Science and Mathematics, 82(2):91-95, February 1983.

10. National Science Teachers Association, Business-Industry-Education Conference. Pocomo Environmental Education Center, Dingmans Ferry, Pennsylvania, June 22-24, 1981.

1987 TIE WORKSHOP EVALUATION

We want to thank you for your participation in the third TIE Workshop. Please take a few minutes to help us make the next one better. Circle our grades and give us your comments.

1.	The TIE mixer with Chemical company exhibits	A	B	C	D	F
2.	The Friday AM Keynote Address- Tom Smolarek	A	B	C	D	F
3.	Grocery Store Chemistry- Doug Nelson	A	B	C	D	F
4.	Plant Constituent Analysis- Karen Pither	A	B	C	D	F
5.	Thin Layer Chromatography- Nancy Luxton	A	B	C	D	F
6.	Modern Environmental Controls- Brad Willett	A	B	C	D	F
7.	Friday Luncheon Address- Dr. Edwin Kaiser	A	B	C	D	F
8.	Teaching Environmentally- Steve Schneider	A	B	C	D	F
9.	Blue Group - Marie Sherman	A	B	C	D	F
10.	Green Group - Gene Cornell	A	B	C	D	F
11.	Red Group - Bob Suits	A	B	C	D	F
12.	Yellow Group- Carol Thieman	A	B	C	D	F
13.	Resource Recovery- Sandra Leigh Custard	A	B	C	D	F
14.	Chemistry Fair!	A	B	C	D	F
15.	DNR Tour	A	B	C	D	F
16.	The DNR Laboratory- Jim Long	A	B	C	D	F
17.	The Ramada Rooms	A	B	C	D	F
18.	The Ramada Food	A	B	C	D	F
19.	The Overall Workshop Planning	A	B	C	D	F

20. If you were to add just one thing, what would it be?

21. If you were to subtract just one thing, what would it be?

22. Should we have more of these workshops? ____Yes ____No
Please explain briefly.

TIE WORKSHOP EVALUATION SUMMARY

Grade Point Average by Year

		1987	1986	1985
1.	The TIE mixer with Chemical company exhibits	3.22	3.23	3.61
2.	The Friday AM Keynote Address- Tom Smolarek	2.80	N/A	N/A
3.	Grocery Store Chemistry- Doug Nelson	3.69	3.85	3.69
4.	Plant Constituent Analysis- Karen Pither	3.31	N/A	N/A
5.	Thin Layer Chromatography- Nancy Luxton	3.62	N/A	N/A
6.	Modern Environmental Controls- Brad Willett	3.18	N/A	N/A
7.	Friday Luncheon Address- Dr. Edwin Kaiser	3.75	3.36	???
8.	Teaching Environmentally- Steve Schneider	2.72	N/A	N/A
9.	Blue Group - Marie Sherman	3.70	3.83	3.78
10.	Green Group - Gene Cornell	3.17	3.50	3.44
11.	Red Group - Bob Suits	3.28	3.47	2.98
12.	Yellow Group- Carol Thieman	3.72	N/A	N/A
13.	Resource Recovery- Sandra Leigh Custard	3.42	N/A	N/A
14.	Chemistry Fair!	3.76	N/A	N/A
15.	DNR Tour	3.20	3.31	3.50
16.	The DNR Laboratory- Jim Long	3.25	N/A	N/A
17.	The Ramada Rooms	3.19	3.37	3.49
18.	The Ramada Food	3.55	2.54	3.37
19.	The Overall Workshop Planning	3.80	3.91	3.88
	Overall GPA(1)...	3.42	3.44	3.53

20. See attached sheets for summary.
21. See attached sheets for summary.
22. See attached sheets for summary.

1. The Overall GPA includes only the nine items for which GPA's are available for all three years.

1987 TIE WORKSHOP EVALUATION COMMENTS SUMMARY

Item 20. If you were to add just one thing, what would it be?

List of places and methods for chem disposal from the stockroom. Also divide the groups better.

More in Chem Fair.

More area for the industry sessions, so you don't have the interference from adjacent groups.

Scrambled eggs at breakfast.

More time for the sessions and label by name all the special handouts, i.e. the bags etc.

More time for the sessions-possibly 3 days?

More companies at the mixer or time in the various groups particularly computer interfacing.

More on genetic engineering.

A little more time to observe projects.

Make sure you always have hands on experiments-they are wonderful.

More info on how to tap into industry and government on an engineering basis for classroom help.

Much more preparation at the DNR Lab.

Great job, more demos if possible.

Can I come again?

More demcnstrations, they were super.

Bus to lab (DNR).

Even more demonstrations of experiments, if we could find the time.

Do a specific environmental lab.

Food companies participating.

A. Have industrial reps in on teacher meetings. B. Heat to meeting rooms.

I would change nothing. Very Good.

Make Chemistry Fair a little more interesting and exciting.

More time spent for brainstorming ideas with other teachers.

More time for 9-12.

1 or 2 more Fair displays.

Provide a bus for the tour in that a portion of the people did not drive.

Means for participants from each region meeting at end of workshop to set-up means to continue as a group in each of their regions.

Better lighting for slides. More company displays for mixer. Really did not have enough time to do "labs" in our groups.

Several planned breaks during the day.

More teacher participatien activities. Allow more teachers to participate in the chemistry fair with a demcnstration or something.

More specific resources or info about chemical disposal or pick-up.

1. Establishment of an information disseminating network with a newsletter (2/yr?) for TIE alumni. 2. Invitations for participants to bring their favorite lab or activity and show them in the "chemistry fair". 3. Realistic help or guidelines for chemical disposal.

More activities with smaller groups.

More time to discuss chem. individually with teachers.

More examples or methods of chemistry incorporating computers into the classroom.

More time to interact with industrial representatives.

List of industry - environmental contact persons that describes their major area of expertise.

More on safety, chem disposal, accident prevention. Chem teacher newsletter?

Time to question speakers, especially Tom S.

Wish we could look forward to something like this every year, even at our own expense, it was that good.

More specific information about what to do about chem. in lab.

More displays by companies.

Spend more time with the chemistry lab portion of the DNR tour.

Replace DNR tour with presentations similar to Friday.

Specifics on what chemicals we need to get rid of in lab and how to dispose of it.

Have a Chemical Company tell more about product manufacturing and how handle chem. like cyanmide, on how they handle chem. waste.

Informal Friday night meal (Fish fry, etc.).

More individual sessions.

Perhaps have teachers bring copies of favorite lab to copy off and distribute.

Item 21. If you were to subtract just one thing, what would it be?

The poor PA system.

Nothing.

I thought for 15 minutes and could not come up with even one thing I would eliminate. the whole workshop was great!

It was great.

Nothing.

The bad microphone system.

DNR lab. Make more interesting examples of problems. Talk about facts about State of MO like Steve Schneider did at end of conference Talk more about ecosystems-tie together chemistry and biology. Talk about parks in Missouri and springs and lakes-many participants are not MO natives.

I really can't think of anything.

DNR lab Tour.

Be as positive as possible at end... Neil Holmes should have said, "And be sure to write a letter of Thanks to your sponsor..." in a positive note not a negative note.

The DNR was awful. Their people seemed unconcerned which aggravated me especially when Steve Schneider preached to us for a 1 1/2 hour about why we should be environmentally concerned. Also I felt they were very unknowledgable.

I can't think of anything.

Nothing.

DNR length of tour--lab was good to see.

Nothing.

Too much sitting and information on Friday.

One less speaker so there would be more time for sessions.

Wasn't impressed with DNR Representatives. (enjoyed tour and lab.)

No smoking.

I can't think of anything I would subtract.

Nothing.

Have less speeches.

Nothing.

I wouldn't subtract anything.

Have 4 groups meet in just 1 room at the same time.

Sitting in one room, in same chair, for 2 hours.

DNR tour--did not add to conference at all.

Tour of DNR.

None.

Waste Management Water polution.

Tom Smolarek.

Long speeches.

Item 22. Should we have more of these workshops?

Yes. If possible please consider tours of chemical plants and/or workshops on safety in the labs and stockrooms.

Yes. You used the time very effectively--I really appreciated all the "hands-on" material, and the concentrated efforts of everyone was great! Very valuable--I would recommend this to anyone! It has helped me get so many ideas for teaching! and community involvement--and industry's role. Thank you--everyone was friendly--accomodations were great--participants were all helpful, too! Chemistry Fair was a very good asset to your program. This is the 1st conference that I could actually use all the information.

Yes. I believe these workshops do three things. 1. Rejuvinate your attitude by being with other teachers. 2. Evaluating your own science program from a standard set by a group. 3. Encouraging you to interface with the industry of the community and realize them as possible resources.

Yes. Because it's good. Can we come more than 1 year?

Yes. This workshop is extremely useful in making educators aware of available help in the classroom--as far as careered new ideas.

Yes. Very valuable.

Yes. I think this was a very worthwhile activity--My students should benefit.

Yes. This is a great way to talk and exchange ideas with my fellow teachers and people from industry.

Yes. Any one session would have made it a valuable addition to my teaching repertoire: we had--what, 8, 10, 12?

Yes. This was an excellent opportunity for me to learn from other teachers and gain great experience. I would definitely recommend this to other teachers.

Yes. Next year.

Yes. Workshops like this make me feel appreciated and renew my pride in the work I do. Teachers don't get enough of this. It also provides the opprotunities to discuss problems/successes with fellow Chemistry teachers.

Yes. The interactions involved here ($T^{I}E$ and $T\ T$) are valuable to the classroom teacher of chemistry.

Yes. This was an extremely beneficial experience.

Yes. Good for new teachers.

Yes. Teachers need the interaction with other teachers. We need these kinds of demonstrations to keep us excited about teaching chemistry.

Yes. Many teachers need exposure to red examples in industry and environment.

Yes. The take-home materials are fantastic. Thank you. I feel the contact with fellow teachers was great.

Yes. I think it is extremely important for this type of interaction. Just as the students don't realize the work that goes into preparing a lab, I didn't realize all the work that goes into preparing for this meeting. Thanks.

Yes. Useful in terms of making contacts, obtaining ideas and information.

Yes. They were very informative, especially the workshops by high school teachers.

Yes. These are so helpful! Also, talking to industry people (making contracts, etc.) of the handouts were very helpful and exciting! Thank you for an excellent workshop!

Yes. Enjoyed hearing industries concerns about the environment from them--not from the media.

Yes. Good for new teachers.

Yes. Excellent.

Yes. Conference is extremely valuable! Special thanks to Dow Co. Why not have representatives from the chemical companies that we order our school supplies from?

Yes. I appreciate the opportunity to get with other teachers and discuss ou similarities, differences, strengths, and weaknesses.

Yes. Excellent resource.

Yes. Excellent! Great practicality!

Yes. Definitely--it is a great help to teachers to find out more information and what others are doing.

Yes. I have learned of many sources of new information sources. This is important to teachers.

Yes. The more teachers that could be involved would be a very definite positive effect.

Yes. Perhaps organized regional, district, or area teacher exchange programs. This could be arranged by area teachers, similar to conference (athletic) superintendents, principals, and coaches meeting.

Yes. Thank You!!

Yes. Contact with Chemistry teachers from areas across the state.

Yes. Definitely! I thoroughly enjoyed it. Most important, "It picked-me-up", motivated me to want to do a better job while at the same time let me know that I have been doing a good job.

Yes. Very interesting and very informative. Made many new contacts.

Yes. I did get many ideas to take back to school. I'll be digesting this material for a long time. I will also be many years in attempting to implement it.

Yes. These workshops help to stimulate--to get a sense of what others do, similar students, budgets, etc. Also liked meeting folks from industry.

Yes. Excellent learning and sharing experiences.

Yes. It made me aware of the Chemical Co. I wish they covered more about type of working procedures and job opportunities

Yes. Every chemistry teacher in the state should be given the opportunity to participate. furthermore, many of us who have attended would like to again, especially if the variety of the presentations changes over the years.

Yes. I've enjoyed the ones in the past through DNR--especially Wast Management Conference.

Yes. It has been a good opportunity to get new ideas and to share ideas with other teachers. it has been very beneficial to learn about environmental issues and their applications.

Yes. I thought it was great. I learned more than I would have in years on my own.

TEACHERS, INDUSTRY AND ENVIRONMENT

Project Final Report
NSF Grant No. TEI-8650101

Table I.*

Professional Teacher	Industry Person	Environmental Person
3.75	2.80	2.72
3.70	3.69	3.42
3.17	3.31	3.20
3.28	3.62	3.25
3.72	3.18	
<3.52> Mean	<3.32> Values	<3.15>

*See page -4- of Final Report.

ONE-WAY ANALYSIS OF VARIANCE
(see Table I above)

Group	Mean*	Std. Dev.
Prof. Teacher	3.475	.2928602
Industry Person	3.355	.4051781
Environ. Person	3.148	.3001528

*Only the first four points were used.

ANOVA Summary Table

Source of Variation	SS	df	MS	F	p
Between groups	.2196045	2	.1098022	0.969	0.582
Within groups	1.020081	9	.1133423		
Total	1.239685	11			

Teacher-Industry-Environment
Pre-Worksnop Questionnaire
(version T87.2)

Please write in your name and social security number in the spaces provided. Then answer each of the questions which follow by circling the response of your choice.

Name_____ S.S.N._____

1. Of the approximately 24 member companies of the Chemical Council of Missouri, how many can you name?

   (circle one) >19 19-15 14-10 9-5 4-1 0

2. Of the companies involved in the Missouri chemical industry in your vicinity, to how many have you taken your class on a fieldtrip?

   (circle one) >4 4 3 2 1 0

3. Of the companies involved in the Missouri chemical industry, how many individuals within these companies would you feel comfortable contacting for assistance with your classroom teaching?

   (circle one) >4 4 3 2 1 0

4. For any one of the companies involved in the Missouri chemical industry, how many industrial processes utilized by this company can you name?

   (circle one) >4 4 3 2 1 0

5. Of the many products manufactured by companies involved in the Missouri chemical industry, how many can you name?

   (circle one) >4 4 3 2 1 0

6. Of the five divisions of the Missouri Department of Natural Resources, how many can you name?

   (circle one) 5 4 3 2 1 0

7. Of the five policy making commissions assigned to the Division of Environmental Quality, how many can you name?

   (circle one) 5 4 3 2 1 0

8. How many times have your contacted the Environmental Education Specialist at the Missouri Department of Natural Resources for assistance in your classroom teaching within the past 5 years?

   (circle one) >4 4 3 2 1 0

9. How many of your chemistry course activities(laboratory exercises, fieldtrips, guest speakers, etc.) specifically involve Missouri chemical manufacturers and their products?

(circle one) >15 15-11 10-6 5-1 0

10. How many of your chemistry course activities(laboratory exercises, fieldtrips, guest speakers, etc.) deal specifically with the quality of the Missouri environment?

(circle one) >15 15-11 10-6 5-1 0

11. How many of your chemistry course activities(laboratory exercises, fieldtrips, guest speaker, etc.) have you created in the past 5 years which deal specifically with the quality of the Missouri environment?

(circle one) >15 15-11 10-6 5-1 0

Please check the appropriate column for each question below.

Yes	No	N/A	Question
___	___	___	1. Do you have at least one microcomputer available for use in your laboratory teaching?
___	___	___	2. Do you use microcomputers in your chemistry teaching?
___	___	___	3. Do you have a working knowledge of the programming language BASIC?
___	___	___	4. Do you do any programming in BASIC related to your chemistry teaching?
___	___	___	5. Do you use microcomputers as a measuring or data logging device in your laboratory?
___	___	___	6. Do you use non-commercial devices for laboratory interfacing projects?
___	___	___	7. Have you ever attended a workshop concerned with the interfacing of transducers with microcomputers?

On the lines below please indicate your preferred mailing address:

_____

_____

Thank you for your help by completing this form.

Teacher-Industry-Environment
Post-Workshop Questionnaire
(version T87.1)

Please write your name in the space provided. Then answer each of the questions which follow by circling the response of your choice.

Name_____

1. Of the approximately 24 member companies of the Missouri Chemical Council, how many can you name?

   (circle one) >19 19-15 14-10 9-5 4-1 0

2. Of the companies involved in the Missouri chemical industry in the vicinity of your school, to how many would you consider taking your class on a fieldtrip?

   (circle one) >4 4 3 2 1 0

3. Of the companies involved in the Missouri chemical industry, how many individuals within these companies would you feel comfortable contacting for assistance with your classroom teaching?

   (circle one) >4 4 3 2 1 0

4. Of the many products manufactured by the member companies of the Missouri Chemical Council, how many can you name?

   (circle one) >4 4 3 2 1 0

5. As a result of this workshop, how many individuals from the Missouri DNR would you feel comfortable in contacting to obtain help with your classroom teaching?

   (circle one) >4 4 3 2 1 0

6. How many ideas for classroom activities have you obtained from this workshop which relate to industrial applications?

   (circle one) >19 19-15 14-10 9-5 4-1 0

7. How many ideas for classroom activities have you obtained from this workshop which relate to environmental applications?

   (circle one) >19 19-15 14-10 9-5 4-1 0

8. How many ideas for classroom activities have you obtained from this workshop which relate to computer applications?

   (circle one) >19 19-15 14-10 9-5 4-1 0

Do you wish to have housing accommodations made for May 23rd. for the Reporting Conference?

____ Yes, in Hudson Hall.
____ No, thank you.
____ Perhaps. I will contact you.

TIE-87 REPORTING CONFERENCE EVALUATION

Date 23 May 1987 Location Central MO State Group Color Summary

A. Please share your general impressions of the Reporting Conference(todays program) by checking the box most appropriate for each catagory:

	Organization	Objectives	Content	Physical Facilities
Excellent	/15/	/13/	/ 9/	/16/
Good	/ 3/	/ 5/	/ 9/	/ 1/
Fair	/ 0/	/ 0/	/ 0/	/ 0/
Poor	/ 0/	/ 0/	/ 0/	/ 1/

B. Please check the number of presentations made in your group for which you will request additional materials or information.

/2/ None

/12/ 1-3

/4/ 4-6

/0/ 7-9

/0/ More than 9.

C. Please indicate the relative importance of the Reporting Conference(todays program) as part of the T.I.E. Workshop(total program).

/7/ Most Important Workshop Activity

/12/ Important, but not Essential

/0/ Helpful, but not Important

/0/ Not a very useful Activity

/0/ Least Important Workshop Activiy

D. Please indicate the importance of the Reporting Conference(todays program) in helping you structure part of your chemistry/science classes to include the Missouri chemical industries, the DNR and your school's local environment.

/5/ Very Important

/12/ Important, but not Essential

/1/ Helpful, but not Important

/0/ Not very Important or helpful

/0/ Of no Importance

E. Please rate the T.I.E. Workshop(total program) by checking the box most appropriate to each catagory:

Presentations were:	/14/ Very Clear	/4 / Clear	/0/ Unclear
Content was:	/10/ Very Important	/8 / Important	/0/ Unimportant
Materials were:	/12/ Very Useful	/6 / Useful	/0/ Useless
Speakers were:	/7/ Very skilled	/11/ Skilled	/0/ Unskilled
Objectives were:	/11/ Very Clear	/7 / Clear	/0/ Unclear

F. Please rate the T.I.E. Workshop(total program) on the basis of other inservice education experiences:

The workshop was:
/6 / the best I have ever attended.
/9 / better than most I have attended.
/1 / similar to most I have attended.
/0 / worse than most I have attended.
/0 / the poorest I have ever attended.
/2 / my first inservice experience.

G. What was the most positive aspect of the Reporting Conference?

See attached sheets.

H. What would you recommend we do to strengthen future Reporting Conferences?

See attached sheets.

I. Do you intend to use any information you obtained today?_____ If so, how?

See attached sheets.

J. Can the CMSU Chemistry Department be of further assistance to you?_____ If so, how?

See attached sheets.

WHAT WAS THE MOST POSITIVE ASPECT OF THE REPORTING CONFERENCE?

Hearing other ideas--giving me applications to my classroom.

Sharing project ideas and talking to other teachers.

Exchanging ideas.

Teachers sharing with other teachers and exchange of information.

Learning many quick and simple experiments.

Got some good ideas.

Exchange of ideas.

Having a verbal presentation of some of the abstracts that will appear later. It will help when trying to use these ideas.

A couple of the reports.

The exchange cf ideas of teachers.

Fellowship with other teachers.

The presentation of industry's involvement in education and the various possibilities for integration with program.

Sharing practical ideas with classroom teachers.

Learning new ideas for use in classroom.

Hands on experimentation.

(1) Seeing creative applications of chemical principles that are presented to other classes. (2) identifying resource personnel and obtaining addresses to write for materials.

New ideas--sharing of memonics and labs.

Talking with, and sharing information with reference to science.

WHAT WOULD YOU RECOMMEND WE DO TO STRENGTHEN FUTURE REPORTING CONFERENCES?

Keep the presentations short. (50 minutes and 30 min = TOO LONG for me!!)

Have it earlier in the month of May or late April--this still allows plenty of time to prepare a project.

Figure out some way to get more people to attend.

Stress time factor to people. suggest they bring handouts.

Very good as it is.

I thought that by having the chance to exchange useful ideas would be all that was needed--yet many people didn't show.

Hold a different weekend.

I think it is tremendous the way it is.

Do whatever is necessary to insure greater participation.

Maybe this years date was bad!

Make a lab presentations instead of cataloging chemicals. I want new exciting lab ideas.

Get more people to attend.

DO YOU INTEND TO USE ANY INFORMATION YOU OBTAINED TODAY? IF SO, HOW?

Yes. I will use some of the experiments and ideas that are currently being used by other teachers.

Yes. To make my classes better--more interesting.

Yes. Lab safety.

Yes. I would like to incorporate most of the activities presented.

Yes. Don't know yet but will probably use parts in many classes.

Yes. To modify a couple of existing activities and perhaps add 1 or 2 others.

Yes. To integrate into my classes, new material.

Yes. As an idea for a science fair project.

Yes. Physical science class--use of spoons and weights. Trying to indure more critical thinking.

Yes. As labs.

Yes. Will be able to teach skills with some of this material.

Yes. New ideas for labs and projects.

Yes. Going to incorporate some of them into my science curriculum.

Yes. Experiments in lab (many).

Yes. In class experiments and/or demonstrations.

Yes.

X

YES!!!

CAN THE CMSU CHEMISTRY DEPARTMENT BE OF FURTHER ASSISTANCE TO YOU? IF SO, HOW?

Help me get rid of my chemicals!!

Yes. By disseminating information on these presentation to all of us.

No.

Yes. Would love some list to help separate my chemicals. They're all in 1 cabinet. #16's presentation may help. (It did some)

?

No. Not at this time--maybe next year. Thanks.

I'll let you know.

No.

I intend to contact an emeritus chem teacher for help in determining age of a bone.

Yes. I need to take a noncalculus based chem course in physical chemistry if available.

No.

Yes.

Yes. Informing teachers of events and seminars similar to TIE. At the high school level, we rarely obtain valuable notices such as these.

Yes. Let me know about NSF programs or new coordination between high school and elem. school science.

Yes. In having more of this type of workshops. Thanks.

T.I.E. PARTICIPANT SURVEY

Appendix IV

NAME Summary of Results Reported in Percentages

I. PERSONAL

1. Circle the year you were a T.I.E. participant. 37% 86-87 31% 85-86 32% 84-85

2. Circle the number of H.S. chem classes you teach. 0 1 2 4 5

3. Does your current principal know about T.I.E.? Yes 95% 5% No

4. Have you visited with your sponsor? Yes 43% 57% No

II. PROJECT: Make a check mark in the appropriate space to indicate your agreement (disaggreement) with each of the following statements.

	*SA	A	N	D	SD
1. Our school teaches chemistry only to those who are going on to college.	6	28	13	36	16
2. I got some good teaching ideas from the T.I.E. Pro ram.	35	64	1	0	0
3. I believe Missouri Chemical Council industry really cares about H.S. science teachers.	38	52	10	0	0
4. Since T.I.E. I feel more comfortable talking to industry chemists.	11	48	38	3	0
5. Environmental Science should be taught in all science classes.	41	48	6	3	1
6. Kids in our school are interested in consumer chemistry.	6	61	27	5	0
7. I have shared ideas with other T.I.E. teachers.	9	54	21	12	2
8. Our chem curriculum is concept driven.	12	61	20	2	1
9. I have cleaned up our chemical storage.	21	52	13	10	2
10. We don't teach any organic chem.	5	24	13	36	20
11. I would like to attend another T.I.E.	57	31	10	2	0
12. T.I.E. should give more concrete examples like toothpaste.	32	57	11	0	0
13. T.I.E. should have commercial suppliers exhibits.	23	61	9	6	1
14. We would like to know more about "basic" industrial resources.	27	68	4	1	0
15. Missouri has lots more chemical industries than I thought.	32	51	13	3	0
16. A microcomputer should be available for use in my laboratory.	50	34	11	4	1
17. Microcomputers are essential to my chemistry/science teaching.	6	32	34	21	5
18. Computer programming should be taught along with science teaching.	14	29	28	22	7
19. Microcomputers as data logging devices are not useful.	2	2	20	38	36
20. Non-commercial devices for laboratory interfacing are advantageous over commercial devices.	6	22	61	7	1
21. Microcomputer interfacing workshops are not useful for high school teachers.	1	2	14	45	37

*SA=Strongly Agree A=Agree N=Neutral D=Disagree SD=Strongly Disagree

TEACHER, INDUSTRY AND ENVIRONMENT WORKSHOP

TIE-87 Teacher Participant List

(Teacher/Sponsor/School)

1. Gerald Axelbaum/Monsanto Co./Crossroads School
2. Timothy Backes/Mo. Chem. Coun./Tipton R-VI
3. Marjorie Bay/Mo. Chem. Coun./Rock Bridge H.S.
4. Alvis Beersman/DNR/Adair Co. R-I
5. Kathleen Bell/Mo. Chem. Council/Southwest R-V
6. Dennis Bradley/Dow Chemical/Festus Road
7. Joseph R. Brandt/Mo. Chem. Coun./Knox Co. R-I
8. Theresa Brightwell/Mobay Corp./Oak Grove H.S.
9. Bob Brillhart/Mobay Corp./Center Sr.H.S.
10. Betty Buchanan/Ethyl Corp./Acad. Math/Science
11. Charles Busenhart/Carboline Co./St. Louis Univ. H.S.
12. Cynthia Castle/Mo. Chem. Coun./Pilot Grove H.S.
13. Sharon Cato/Monsanto Co./Dora R-III H.S.
14. Joe Clark/Transchem. Inc./Clayton H.S.
15. Beth Cook/CMSU Chem. Dept./Holden H.S.
16. Robert Crockett/Mo. Chem. Coun./Albany R-III
17. Vernice Dirigo/Hercules Inc./Buchanan H.S.
18. Martha Dodson/Monsanto Co./Sikeston Sr. H.S.
19. Gary Eatherton/Monsanto Co./Montgomery Co. R-2
20. Robert Farrell/Buchman Labs/Valley H.S.
21. Steve Fischer/Mobay Corp./Pleasant Hill R-3
22. Rita Floberg/Union Carbide/Liberty Jr. High
23. Byron Foster/Union Carbide/Bishop LeBlond
24. Pamela Gabel/Monsanto Co./Chillicothe H.S.
25. Linda Gaither/CHEVRON Chem. Co./Grace Christian
26. Kim Graves/Alcolac Inc./Smith-Cotton H.S.
27. John Hall/Mobay Corp./Rock Port R-II
28. Roslyn J. Harmon/Monsanto Co./Washington Sr.H.S.
29. Jeff Howell/Mallinckrodt/Holcomb H.S.
30. Bill Jameson/Amer. Cyanamid Co./Hannibal Jr. High
31. Frank S. Johnson/Mo. Chem. Coun./Greenfield H.S.
32. Theresa Johnson/Mo. Chem. Coun./Dadeville R-II
33. David Johnston/SYNTEX Agri-Bus./Aurora H.S.
34. Terry Keeton/CHEMCENTRAL/Center Sr. H.S.
35. Theresa Kendrick/Amer. Cyanamid Co./Palmyra Sr. H.S.
36. Virginia Kirwin/A.I.Ch.E./Ursuline Academy
37. Jane Lynn/Monsanto Co./Crawford Co. R-I
38. Daniel S. Lane/Mallinckrodt/University City H.S.

39. Kerry Magruder/Mallinckrodt/Eureka Sr. H.S.
40. Connie Montgomery/Monsanto Co./West Plains R-7
41. Richard Nolte/Monsanto Co./McKinley H.S.
42. Mrs. Artie Pearson/Mo. Chem. Coun./Hermitage H.S.
43. Nathan Peck/Monsanto Co./Mary Institute
44. Phyllis Perry/Mo. Chem. Coun./Jefferson City H.S.
45. Ted Pethtel/Adco Inc./Sedalia Mid. School
46. Dan Phillips/Monsanto Co./Rock Bridge H.S.
47. Wilma Pollock/Monsanto Co./Hazelwood East
48. Roger Price/Farmland Indust./Central H.S.
49. Evelyn Roach/Monsanto Co./O'Fallon Tech.
50. Laurann Robertson/Eagle-Picher/Lamar High School
51. Marc Romine/Dow Chemical/Russellville H.S.
52. Harlan Sadler/Mo. Chem. Coun./Scott City H.S.
53. Sue Salamon/Monsanto Co./Wentzville H.S.
54. Thurlow D. Schauffler/E.I. DuPont Co./Westran H.S.
55. Jo Ann Scheidt/DNR/Callaway Co. R-3
56. Alberta Shaw/Amer. Cyanamid Co./Marion Co. R-2
57. Andrew Shaw/Chemtech Indust./W.Minster Christian

58. Charles J. Smith/Mo. Chem. Coun./Osceola H.S.
59. James D. Smith/Monsanto Co./Notre Dame H.S.
60. Br. Mark Snodgrass/Mobay Corp./Archbish. O'Hara
61 Michael Spitz/DNR/Helias H.S.
62. Sr. Kathy Sullivan, SL/Merck and Co./Rosati-Kain H.S.
63. Richard R. Summers/SYNTEX Agri-Bus./Willard H.S.
64. Edwina Taylor/Mallinckrodt Hancock H.S.
65. Judy Taylor/Monsanto Co./Poplar Bluff H.S.
66. Oleta M. Thomas/PPG Industries/Hazelwood West
67. Cliff Tucker/Amer. Cyanamid/Canton R-V
68. Joan Twillman/N.L. Industries/St. Charles West
69. Linda Wilson/Atlas Powder Co..Webb City H.S.
70. Lance Winkler/DNR/Jefferson City H.S.
71. Kathy Wright/Monsanto Co./Central H.S.
72. Connie Wyrick/DNR/Cole Co. R-V
73. David Yates/Chlorox Corp./Smithville H.S.

TIE-87 Industrial Sponsor List

1. Farmland Industries/St. Joseph
2. Union Carbide/St. Joseph and N. Kansas City
3. Department of Natural Resources/Jefferson City
4. SYNTEX Agri-Business/Springfield
5. CHEMCENTRAL/Kansas City
6. Chlorox Company/Kansas City
7. Mobay Corporation/Kansas City
8. Atlas Powder Company/Joplin
9. Eagle-Picher Industries/Joplin
10. Dow Chemical/Pevely
11. CMSU Chemistry Department/Warrensburg
12. American Cyanamid Company/Hannibal
13. Adco Incorporated/Sedalia
14. Alcolac Incorporated/Sedalia
15. Hercules Incorporated/Louisiana
16. E.I. DuPont/Moberly
17. A.I.Ch.E./St. Louis
18. Carboline Company/St. Louis
19. Missouri Chemical Council/Chesterfield
20. Chemtech Industries/St. Louis
21. CHEVRON Chemical Company/Maryland Heights
22. Ethyl Corporation/St. Louis
23. Mallinckrodt Incorporated/St. Louis
24. Merck and Company/St. Louis
25. Monsanto Company/St. Louis
26. N.L. Industries/St. Louis
27. PPG Industries/Chesterfield
28. Transchem Incorporated/St. Louis
29. Buchman Labs, Incorporated/Cadet